Art. XXIV.—*On Purification of Water.* By Mr. J. G. W. Dahlke, M.S.A.L., &c.

[Read by Dr. J. E. Neild, 11th November, 1867.)

It is well known that pure river and spring water contains an inexhaustible amount of nutriment from which plants derive their principal food, and indeed this fact accounts for many mysterious phenomena in regard to the physiology and culture of plants and animal life. But little attention is paid as yet to the subject by the public at large, with whom brightness and palatableness of the water pass invariably for guarantee of good quality. However this is but a poor criterion to go by, because it is quite possible that water, being coloured and having an unpleasant taste, may be wholesome, whereas bright and good tasting water can be, and not seldom is, poisonous to a high degree.

I remember a case which occurred in London some years ago. There was a public pump in the parish of St. James', which for generations had the reputation of yielding the most healthy water in that neighbourhood, and people were in the habit of sending for it from considerable distances. Now, it happened at the time of the cholera that this district suffered far more than might have been expected, it being well ventilated and generally considered healthy. The medical men therefore suspected an influence, the origin of which had escaped their notice and caused a stringent investigation; but in vain, until it occurred to the district Medical Officer of Health (I believe Dr. Lankester) to examine the water. Of course this pump came also under his notice, and sure enough the analysis proved that the so highly esteemed water was to a high degree injurious, holding an excess of organic matter kept in solution by an abundance of acids. When known, it was easily accounted for, because the so-called London valley has a gritty and loose soil which rests upon a thick layer of rich clay, therefore the wells sunk in it must get contaminated from the filth which will necessarily accumulate in such a vast city. A few years afterwards, the medical faculty of London became alarmed from the fact that lead poisoning cases had been noticed, and Dr. Letheby, with whom I happened to be in personal correspondence about the purification of the water of the London drinking fountains, told me that he had good reason to suspect the leaden supply pipes, etc., of

getting attacked, and particularly so if the water was strongly impregnated with organic matter. I had paid a good deal of attention to the subject at the time, and, from my practical experience, I knew well that the Doctor was right in his surmise. To more than half of about two hundred water tanks, which I inspected, *none or hardly any* attention had been paid to the cleansing and vegetation, and animalculæ were flourishing in abundance.

The lead which lined the inside had in many instances the appearance of corrosion, and when the test was applied, it proved the presence of lead in the water.

There has been a great controversy as to how ordinary water may attack lead. The theory in which I believe is this, that in the first instance it emanates from the dissolving action of soft water, which rapidly accelerates when in motion, and the pressure of organic matter when in a state of repose. Lankester and others assert that experiments have proved it beyond doubt that distilled water will dissolve lead to a limited extent.

To be wholesome, the water used for drinking and ordinary purposes must be free from injurious matter. I don't mean that it should be *pure* in the literal sense of the word, indeed there are bodies, such as iron, carbonic acid gas, etc., the limited presence of which might be considered rather co-inducive to health than otherwise, and I have not unfrequently employed such media as will cause an impurity in this direction, when I had soft and flat water to deal with.

Contrivances to purify water for domestic purposes have been known since time immemoriable. The old inhabitants of Egypt, the Greeks, and the Romans had them. Sponges were used to free the water of the Niger from its accidental contaminations. The Japanese use a porous stone, hollowed in the form of an egg, and set in a frame over a vessel into which the water drops as it percolates through the stone. The Egyptians have the same for the filtration of the water of the Nile.

A favourite medium in France is a porous limestone, found, I believe, in Brittany, and a similar one used to be imported into England from Teneriffe, but is not so now, because equally good filterstones are found in Derby and Northamptonshire, besides, other media have supplanted them in modern times.

In the latter part of the last century the filteration of water seems to have attracted public attention in England,

and we find that in 1790 and 1791 patents were taken out, one by a Chelsea potter, for a new filtering medium, which he made of pipeclay and coarse sand ; the other for a somewhat complicated apparatus, the patentee using sand, charcoal and other loose materials.

Various contrivances have been introduced since then, more or less similar to each other, some acting by ascension, some by descension, and in fact the numbers of patents taken out to protect what has been known for centuries is innumerable, and persons have been always ready who, though perfectly unacquainted with the real requirements of filtration, would insist upon introducing their wares as capable of doing impossible things, just as quacks will recommend their patent compounds as a certain remedy for diseases of which they know nothing themselves.

Of course, since the water becomes contaminated from various influences, the filter ought to be made accordingly ; a medium which is recommendable for hard water will not do for soft water, and again, flatness may have to be contended with, which in itself requires a particular treatment.

Thus the public could not fail, in course of time, to perceive that they were imposed upon, and the notion that filter makers were more or less mere pretenders, has become general.

Competent men however have taken the matter in hand, amongst whom is Dr. Clarke, who introduced the system of purifying water by adding quick-lime to it.

Pure water will absorb two grains of carbonate of lime per gallon, and if the water takes up carbonic acid, this quantity may be increased to about twenty grains. The caustic lime when added, will seize upon the carbonic acid present and render the carbonate of lime in solution insoluble, which, falling to the bottom, carries some of the organic impurities along with it. It is a beautiful manipulation, and answers well on a large scale (if the water be hardened from a superfluity of lime). Dr. Clarke having also introduced a test by which the degree of hardness of the water may be ascertained, to determine what quantity of lime should be added. Excess is easily tested with nitrate of silver. But unfortunately this process does not answer for domestic purposes, requiring as it does removal for each supply, besides it would not affect soft water and lead.

A similar method is that of adding alum, which will decompose in the water, and fall to the bottom in insoluble

precipitates, taking with them alumina and other impurities which discolour the water. But this process has the drawback that but a slight excess of alum will form sulphates of lime, which, remaining in solution, causes hardness.

The mechanical difficulties of constructing an effective and lasting filter for domestic use are many and have caused many failures. The maker must not only be thoroughly acquainted with the nature of the water he has to deal with, but he must also well consider the local influences. He may have excess of pressure in the supply or want of it. Moreover, he has to study the convenience of his customers, if he wishes for complete success.

A water which is sufficiently pure in itself, and only subject to accidental and occasional contamination offers no difficulty. The case however is different if, for instance, it holds lead and excess of organic matter in solution. Here he has not only to remove this impurity, but he runs the risk of getting flat water, on account of its being invariably of a soft nature in this case. With due regard to the porosity of the filtering medium, in accordance with the pressure of the supply, the filter maker will principally choose animal charcoal corrugated with steel. The lead coming in contact with animal charcoal precipitates instantaneously, and the joint action of the media employed will reduce the organic matter to a minimum, causing at the same time the water to be bright and sparkling.

To describe the mechanical arrangements of apparatuses for various purposes would be out of place. I may merely mention that the small filter which I have brought here has only been constructed for conveniently testing the filtering medium for given purposes.

Much as I prefer animal charcoal to other materials in many cases, it would be folly to overrate its qualities by adopting it as a cure for every impurity which may be found in water.

In 1860, in a letter which I wrote to *The Times*, public attention was called to the fact that animal charcoal, when judiciously employed, will remove solution of lead from water. It was amusing to see how nearly all the London filter makers at once adopted the cry for their advertisements :—" No more lead in water," and commenced using nothing but animal charcoal for their filters, thinking that this was all that could be desired. Of course their ignorance led them astray again, because the effect of animal charcoal

upon water which is hardened from the presence of acids and salts is but limited, and other substances, such as pure silica, &c. (having a great affinity for them) are far more effective.

About ten years ago I found quite accidentally a most valuable filtering medium in the refuse of boghead coal. It appears that this coal yields more gas than any other kind known; but, instead of coke, it leaves a pure silica of a very spongy nature—closely amalgamated with about ten to fifteen per cent. of carbon.

By means of a simple process of my own I convert this substance into solid cakes of such size and porosity as may suit the different purposes, and thus I get not only a very effective filtering agent in quality; but, in this form it assists me greatly to overcome mechanical difficulties.

I have patented this material under the name of silicated carbon, by which it is well known in England. Various Government establishments, amongst which the General Post-office, the hospitals, and the public drinking fountains have adopted it; in fact the latter introduced it to the public at large.

A lawsuit relating to the Boghead coal called my attention to it. The lessee of the mine denied it to be a coal, because it would not yield coke when distilled. A great sum of money being at stake, there were a great number of scientific men called upon to give evidence, and the battle became very fierce. Becoming interested in the feud between the various and differing members of the learned faculty, I profited greatly by finding a new and valuable filtering medium in the form of such a spongy silica as I had not met with before.

This silicated carbon has been highly valued by the profession, and Drs. Letheby, Waller, Lewis, Odling, Buchanan, Lankester, Noad and others used to support me strongly whenever I needed their aid.

But a very few days ago I read an abstract of an article which the well-known water analyst, Dr. Rivers (to whom I am personally unknown), wrote for the "Popular Science Review," in which he discriminates the merits of the various filters now used in England. It was very pleasing for me to find that amongst the three systems which he has proved to be reliable for what they profess to do, he mentioned my own silicated carbon. Of the rest he seems to have formed but a very poor opinion.

This gentleman mentions that he has not extended his researches sufficiently to form a definite opinion as to the action of the three systems to which he refers, when the water is highly charged with carbonate of lime. Had he done so he would have found that in this particular case, silicated carbon would have had the advantage of Spencer's magnetic carbide and pure animal charcoal, on account of the presence of the pure silica. However, to reduce hardness of water, I would not entirely rely upon my favourite material, but get the assistance of other agents. Indeed, as I have stated before, an universal filtering medium does not in my opinion exist.

A competent person will not have much difficulty in devising means for an efficient purification of water, and a judicial arrangement will even overcome brackishness to a considerable extent. I have never had much trouble in reducing Thames water impurities to about half a grain of organic matter per gallon with a low degree of hardness.

Messrs. Danks and Co., of Bourke-street will, in a few days, have a model apparatus which has been purposely constructed to suit the Melbourne water supply. It will entirely remove lead and reduce the organic matter to a minimum, without causing flatness. It can easily be attached to the supply-pipes without interfering with the existing arrangements, having also a simple and effective arrangement for the cleansing.

Another apparatus of a portable form will be particularly suitable for country use, at stations, farms, &c.

Art. XXV.—*On a New Self-Registering Electrometer; or, Electrograph.* By R. L. J. Ellery, Esq., President.

[Read 9th December, 1867.]

I have lately erected an instrument at the Observatory for obtaining a continuous record of the amount and variations of atmospheric electricity, the construction of which I believe is in some respects new; I have therefore thought it worth while to lay a description of it before the Society.

I must premise however that the *main principles* of this electrometer are not new, but were devised and applied by Sir W. Thomson, of Glasgow, some years ago, and he